

HARD DISKS

Today's PCs need huge amounts of storage space to cope with music, video and games. Our definitive labs tests 24 disks to find your best buy

SUPER STORE

INTRODUCTION

When PCs were used only for writing documents and crunching numbers, a few megabytes of storage could hold months of work. Now that we use our computers to store music, photos and video files, it's all too easy to fill up gigabytes of space and find yourself needing more. CDs and DVDs can hold quite a few files, but for speed and convenience nothing beats a hard disk.

There are a bewildering number of internal hard disks available and it can be tempting just to choose the model with the lowest price or the biggest capacity. If you do this, though, you could end up with a noisy PC, disappointing performance or an inadequate warranty. This month we've tested 24 of the latest hard disks, from inexpensive 80GB models to huge 500GB disks that can hold an entire video collection with room to spare. Whatever you need, we'll help you find the perfect hard disk for your system.

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storage expert



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Choosing a... Hard Disk

Hard disks all look much the same, but the range of features and specifications on offer can be bewildering. Read our guide to find out what you should look out for, and what you can safely ignore.

LORD OF THE FILES

Internal hard disks connect to your PC using either the Parallel ATA (PATA) or newer Serial ATA (SATA) interface. The type you should use depends on which connectors are available on your motherboard. Most PCs sold in the past couple of years should have at least one free SATA socket, but older PCs may have only the two-inch-long connectors used for PATA cables.

SATA cables are easier to use since they are less bulky and cumbersome than the thick, ribbon-like PATA cables. The most recent version of PATA has a maximum theoretical speed of 133MB/s, whereas the most recent version of SATA, SATA II, has a maximum theoretical speed of 300MB/s. You will never see such dramatic transfer rates in practice, but the best SATA disks tend to be slightly faster than their PATA counterparts.

PATA hard disks require a standard four-pin Molex power cable. Some SATA disks can use a Molex power

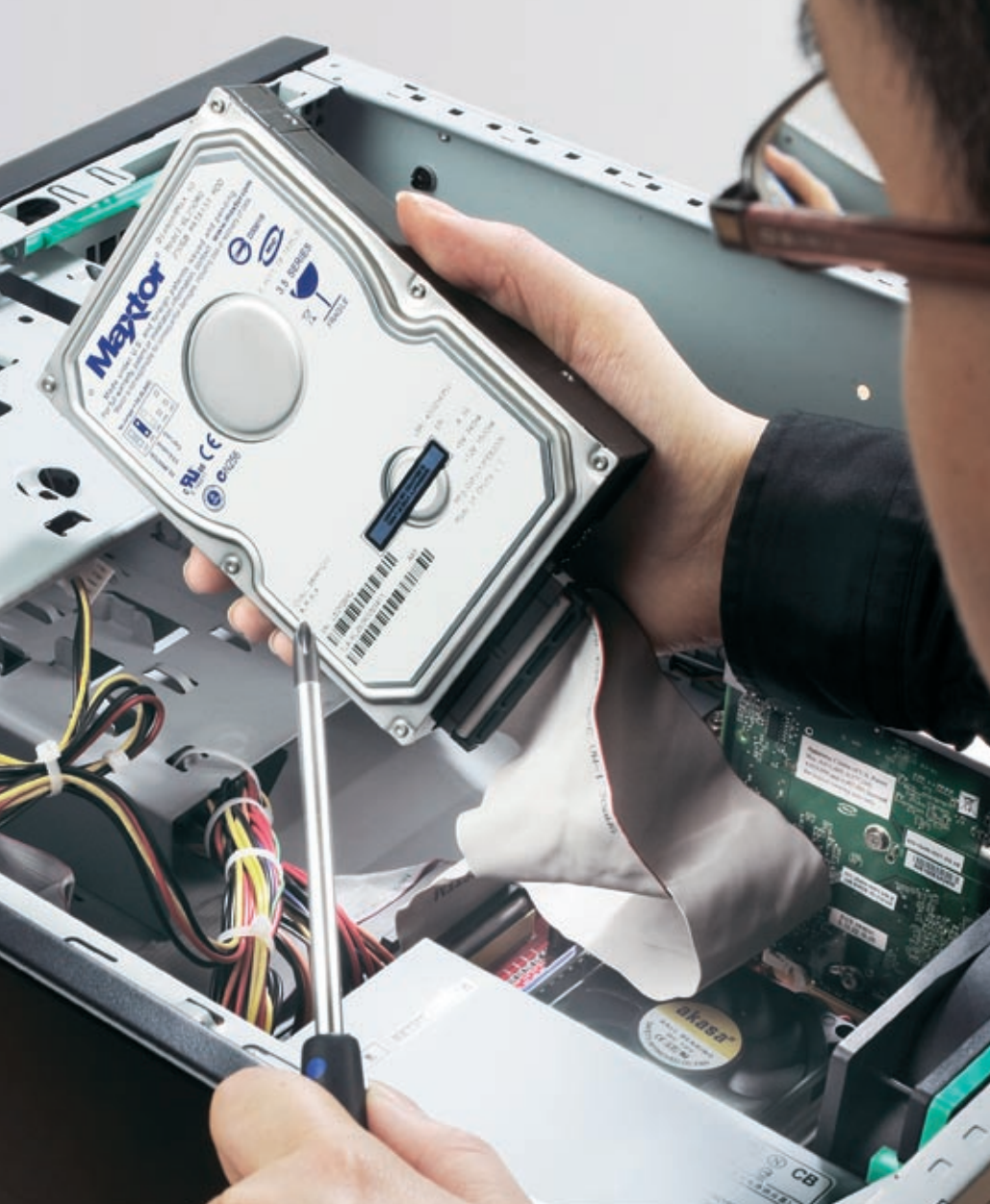
connector, but others require the newer SATA power connector instead. If your power supply doesn't have any SATA power leads, you can buy a converter for around £4 including VAT from www.maplin.co.uk. The tables on page 88 and 90 show which type of connector is required by each disk.

COMPATIBILITY CONDUNDRUMS

There are two different versions of SATA. The original standard, also known as SATA I and SATA 150, supports a theoretical top speed of 150MB/s. SATA II, also known as SATA 300 and SATA 3Gb/s, supports a maximum speed of 300MB/s.

Most of the SATA hard disks in this month's test support SATA II. SATA II disks aren't twice as fast as SATA I disks, but it's still worth consulting your motherboard's manual or the manufacturer to determine if it supports SATA II or not.

SATA II disks can be plugged into a SATA I port and vice versa. Some SATA II disks, such as those made by Samsung, may have to be set manually to SATA I mode using a small jumper on the back of the disk before they can be plugged into a SATA I socket. Whether or not you have to do this depends on your motherboard.



Some older PCs have problems working with PATA hard disks larger than 137GB. If you're using Windows XP or 2000, installing the latest Service Pack and updates should solve this issue. If your motherboard is the culprit, a BIOS update that fixes this issue may be available, so check on the manufacturer's website. If this isn't the problem, you may have to partition your hard disk. For more details on the 137GB barrier, see www.seagate.com/support/kb/disc/tp/137gb.pdf.

CHAIN OF COMMAND

All SATA II disks and some SATA I disks support Native Command Queuing (NCQ). This allows the disk to prioritise the multiple read and write requests it is sent, re-ordering them so that they can be executed efficiently.

In order for it to have any effect on performance, NCQ must be supported by both your hard disk and motherboard. We ran all our tests using a motherboard that supports NCQ to ensure the best possible results.

RAM RAID

The lower a hard disk's cost per gigabyte, the more you're getting for your money. In this test we found that 250GB hard disks have the lowest cost per gigabyte, and that models with smaller or larger capacities tend to be less cost-effective.

If you need more than 250GB of space but still want to take advantage of good-value 250GB disks, you could join several together in a

How we test Hard disks

There is no single specification that determines how fast a hard disk runs. Everything from the speed it spins to the size of its cache memory plays a part.

To test a hard disk's read and write performance, we use an automated script to time file copies. Files are copied from a RAM disk to the hard disk and back again. We use a RAM disk as the source of the file transfer as this is much faster than any hard disk and ensures that we get the best possible performance from the disk.

In the first test, a 100MB file is copied to and from each hard disk 100 times to see how it copes with large files such as videos. In the second test, a selection of small files totalling 100MB is copied to and from each disk. This shows how quickly small files – such as system files – would be transferred during a system backup, for example. We also tested the time taken to access data from each disk using HD Tach.

RAID array (see *PC Builder, Shopper*, January 2006). For help on installing an internal hard disk, read the *Upgrade Shopper* booklet, November 2005. See also page 202 for how to transfer your Windows installation to a new disk.

This month

PATA hard disks

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Maxtor DiamondMax 10 6L250R0
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Maxtor DiamondMax 10 6L300R0
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ST3500641A
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Seagate Barracuda 7200.9 400GB
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Hitachi Deskstar 7K250 HDS722516VLSA8
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Samsung SpinPoint P80 HD160JJ
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Samsung SpinPoint P120 SP2504C
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Seagate Barracuda 7200.9 ST3500641AS
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Western Digital Caviar SE 16
WD3200JD-00KLB0
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Western Digital Caviar SE 16
WD4000KD-00NAB0
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Western Digital Caviar SE 16
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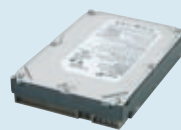
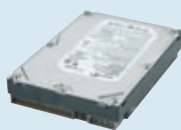
Western Digital Raptor X 150GB
WD1500AHFD
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PATA HARD DISKS

PATA HARD DISKS



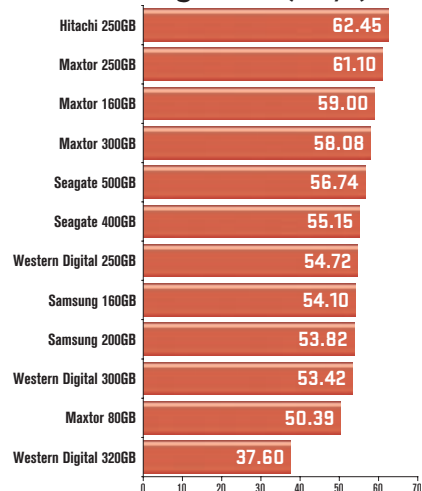
MANUFACTURER	HITACHI	MAXTOR	MAXTOR	MAXTOR	MAXTOR	SAMSUNG
Model	Deskstar T7K250 HDT722525DLAT80	DiamondMax 10 6L080LO	DiamondMax 10 6L160PO	DiamondMax 10 6L250RO	DiamondMax 10 6L300RO	SpinPoint P80 SP1654N
Rating	★★★★★	★★	★★★★	★★★★★	★★★★	★★★
Pros	Consistently fast performance	Fairly fast when reading small files	Fast data-reading rates	Generally good performance; cheap	Good large files performance	Quick at writing small files
Cons	Slightly more expensive than other 250GB disks	High cost per gigabyte; slow with large files	Struggles when writing small files	Struggles when writing small files	Struggles when writing small files	Otherwise uninspiring performance
STORAGE						
Capacity	250GB	80GB	160GB	250GB	300GB	160GB
Formatted capacity (NTFS)	232GB	76GB	149GB	232GB	279GB	149GB
Price per gigabyte	31p	45p	35p	27p	28p	37p
Interface	Ultra ATA/133	Ultra ATA/133	Ultra ATA/133	Ultra ATA/133	Ultra ATA/133	Ultra ATA/133
Power connector	Molex	Molex	Molex	Molex	Molex	Molex
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm
Cache	8MB	2MB	8MB	16MB	16MB	8MB
Quoted seek time	8.5ms	9.0ms	9.0ms	9.0ms	9.0ms	8.9ms
HD Tach access time	16.3ms	16.5ms	16.2ms	16.6ms	16.0ms	14.4ms
Platters	2	1	2	2	3	2
Heads	4	2	4	4	6	4
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	28dBA	25dBA	25dBA	25dBA	25dBA	27dBA
BUYING INFORMATION						
Price inc VAT	£71	£36	£52	£63	£77	£55
Supplier	www.pcnextday.co.uk	www.savastore.com	www.savastore.com	www.savastore.com	www.savastore.com	PC World stores
Warranty	Three years	Three years	Three years	Three years	Three years	Three years
Details	www.hitachigst.com	www.maxtor.com	www.maxtor.com	www.maxtor.com	www.maxtor.com	www.samsung.com
Part code	HDT722525DLAT80	6L080LO	6L160PO	6L250RO	6L300RO	SP1654N
     						

MANUFACTURER	SAMSUNG	SEAGATE	SEAGATE	WESTERN DIGITAL	WESTERN DIGITAL	WESTERN DIGITAL
Model	SpinPoint P120 SP2014N	Barracuda 7200.9 500GB ST3500641A	Barracuda 7200.9 400GB ST3400633A	Caviar SE WD2500JB- 00REA0	Caviar SE WD3000JB- 00KFA0	Caviar SE WD3200JB- 00KFA0
Rating	★★★	★★	★★	★★★★	★★★★	★★
Pros	Fast when working with small files	Satisfactory performance when reading files, five-year warranty	Decent speed when reading files, five-year warranty	Generally respectable performance	Fast when writing large files; cheap	Decent speeds when writing small files
Cons	Less impressive when working with large files	High cost per gigabyte; slow at writing small files	High cost per gigabyte; sluggish write speeds	Slow when reading small files	Not so fast when reading files	Other results are consistently poor
STORAGE						
Capacity	200GB	500GB	400GB	250GB	300GB	320GB
Formatted capacity (NTFS)	186GB	465GB	372GB	232GB	279GB	298GB
Price per gigabyte	31p	42p	37p	28p	27p	29p
Interface	Ultra ATA/133	Ultra ATA/100	Ultra ATA/100	Ultra ATA/100	Ultra ATA/100	Ultra ATA/100
Power connector	Molex	Molex	Molex	Molex	Molex	Molex
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm
Cache	8MB	16MB	16MB	8MB	8MB	8MB
Quoted seek time	8.9ms	8.5ms	8.5ms	8.9ms	8.9ms	8.9ms
HD Tach access time	13.6ms	14.9ms	15.0ms	13.4ms	13.6ms	13.7ms
Platters	2	4	4	3	3	3
Heads	4	8	8	6	6	6
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	25dBA	28dBA	28dBA	28dBA	28dBA	26dBA
BUYING INFORMATION						
Price inc VAT	£58	£197	£138	£66	£75	£85
Supplier	www.savastore.com	www.savastore.com	www.morecomputers.co.uk	www.savastore.com	www.savastore.com	www.savastore.com
Warranty	Three years	Five years	Five years	Three years	Three years	Three years
Details	www.samsung.com	www.seagate.com	www.seagate.com	www.westerndigital.com	www.westerndigital.com	www.westerndigital.com
Part code	SP2014N	ST3500641A	ST3400633A	WD2500JB-00REA0	WD3000JB-00KFA0	WD3200JB-00KFA0
     						

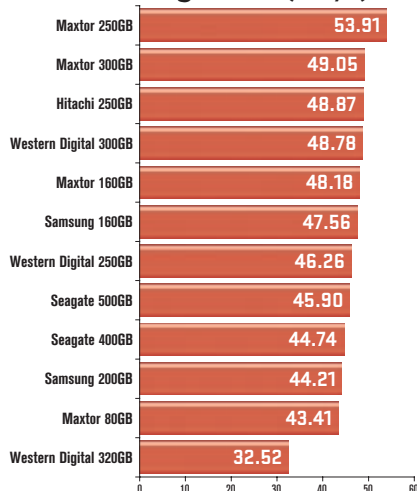
BENCHMARKS

Performance PATA internal hard disks

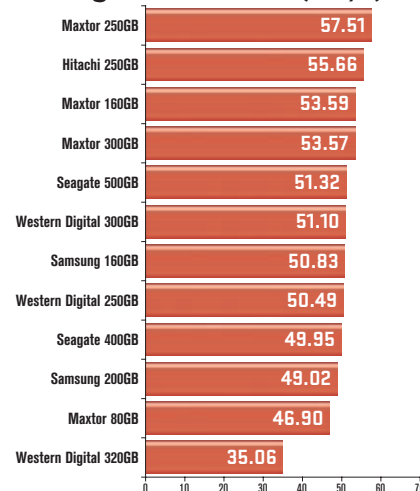
Read Large Files (MB/s)



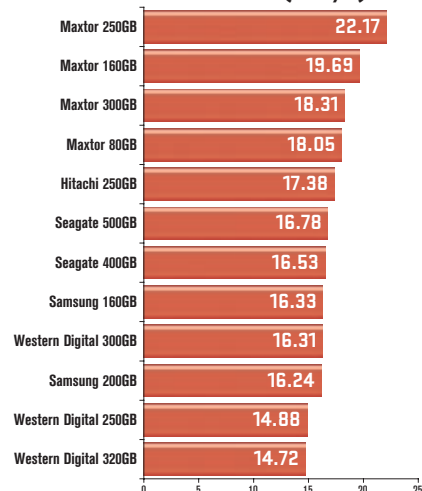
Write Large Files (MB/s)



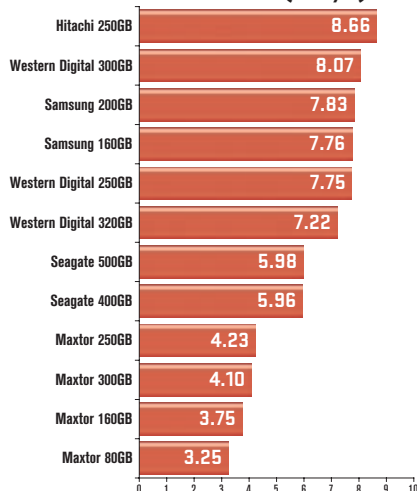
Large Files Overall (MB/s)



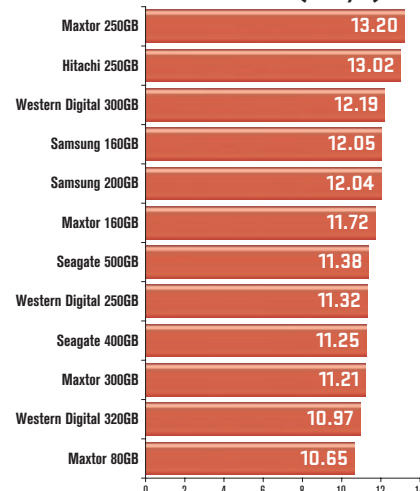
Read Small Files (MB/s)



Write Small Files (MB/s)



Small Files Overall (MB/s)



Labs verdict PATA hard disks

Hard disk and motherboard manufacturers are gradually phasing out the parallel ATA (PATA) interface in favour of the faster and tidier SATA. If your motherboard supports it we recommend buying a SATA disk as it is more likely to work in future computers, but if not PATA disks are still plentiful and cheap.

The hard disks here made by Seagate and Western Digital support the Ultra ATA/100 PATA interface with a maximum speed of 100MB/s. All the others support Ultra ATA/133, which has a top speed of 133MB/s. However, our tests show that having an Ultra ATA/133 interface does not guarantee the best performance. Conveniently, an Ultra ATA/133 hard disk can be safely plugged into any PATA socket, whether it supports the faster standard or not.

If you just need more space to hold a few more photos, Maxtor's 80GB DiamondMax 10 6L080L0 may be worth considering. It's expensive, though, costing 45p per gigabyte of storage, and – apart from when reading small files – its performance is unimpressive.

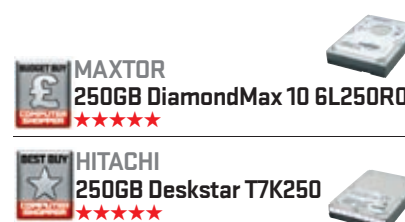
If you need vast amounts of storage space, Seagate's 500GB Barracuda 7200.9 can hold hours of video footage, but its performance is unremarkable and it is slightly expensive at 42p per gigabyte. The 400GB Barracuda 7200.9 is almost as expensive, costing 40p per gigabyte, and performs similarly. Western Digital's Caviar 320GB SE isn't as expensive, costing 29p per gigabyte, but it performed very poorly in three of our speed benchmarks.

With a price per gigabyte of just 27p, the Western Digital Caviar SE WD3000JB is one of the cheapest hard disks here. Although it's very fast when writing files, its read performance languishes at the bottom of the table, making it more suitable as a backup archive than for everyday use.

To add more capacity to your Media Center PC so that you can record and store more of your favourite TV shows, Maxtor's 250GB DiamondMax 10 6L250R0 is a good choice. Although it's not the largest disk in our group, it's very fast when reading and writing large files such as videos. Like the other Maxtor disks

here it suffered in our small file write test, but at a cheap 27p per gigabyte this is easy to forgive. It's our Budget Buy. If you need a bit more storage space, Maxtor's 300GB DiamondMax 10 6L300R0 isn't quite as fast, but it's nearly as cheap.

For good performance in every task, we recommend Hitachi's 250GB Deskstar T7K250. It produced the best result in our large file read test and scored consistently well elsewhere. At 31p per gigabyte it is a little more expensive than the other 250GB hard disks in our group, but this is a small price to pay for a drive that works well in every situation. It's our Best Buy.



SATA HARD DISKS

SATA HARD DISKS



MANUFACTURER	HITACHI	HITACHI	MAXTOR	MAXTOR	SAMSUNG	SAMSUNG
Model	Deskstar T7K250 HDT722525DLA380	Deskstar 7K250 HDS722516VLSA8	DiamondMax 11 6H500F0	DiamondMax 10 6V250F0	SpinPoint P80 HD160JJ	SpinPoint P120 SP2504C
Rating	★★★★	★★	★★★	★★★★★	★★★	★★★★
Pros	Low cost per gigabyte	Acceptable small files performance	Fast at reading large and small files	Low cost per gigabyte; speedy when dealing with large files	Quick when writing small files	Low cost per gigabyte
Cons	Slow when writing large files	Struggles when dealing with large files	Struggles when writing small files	Struggles when writing small files	Slow when reading large files	A little slow when reading small files
STORAGE						
Capacity	250GB	160GB	500GB	250GB	160GB	250GB
Formatted capacity (NTFS)	232GB	153GB	465GB	233GB	149GB	232GB
Price per gigabyte	30p	40p	46p	28p	40p	30p
Interface	SATA II	SATA	SATA II	SATA II	SATA II	SATA II
Power connectors	SATA, Molex	SATA, Molex	SATA	SATA	SATA	SATA
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm
Cache	8MB	8MB	16MB	16MB	8MB	8MB
Quoted seek time	8.5ms	8.5ms	8.5ms	9.0ms	8.9ms	8.9ms
HD Tach access time	12.7ms	12.7ms	16.1ms	15.7ms	14.5ms	14.2ms
Platters	2	2	4	2	2	2
Heads	4	4	8	4	4	4
NCQ	Yes	Yes	Yes	Yes	Yes	Yes
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	28dBA	28dBA	32dBA	25dBA	25dBA	25dBA
BUYING INFORMATION						
Price inc VAT	£70	£61	£216	£65	£60	£70
Supplier	www.dabs.com	www.savastore.com	www.savastore.com	www.savastore.com	www.gladicatorcomputers.com	www.dabs.com
Warranty	Three years	Three years	Three years	Three years	Three years	Three years
Details	www.hitachigst.com	www.hitachigst.com	www.maxtor.com	www.maxtor.com	www.samsung.com	www.samsung.com
Part code	HDT722525DLA380	HDS722516VLSA8	6H500F0	6V250F0	HD160JJ	SP2504C



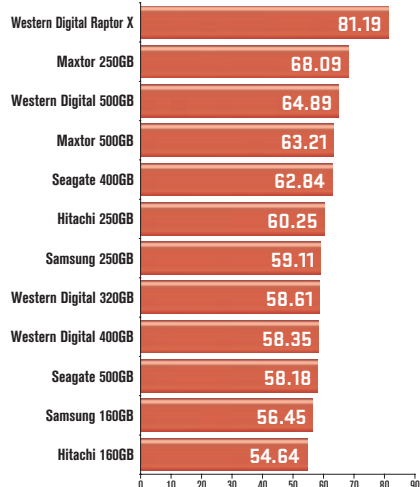
MANUFACTURER	SEAGATE	SEAGATE	WESTERN DIGITAL	WESTERN DIGITAL	WESTERN DIGITAL	WESTERN DIGITAL
Model	Barracuda 7200.9 ST3500641AS	Barracuda 7200.9 ST3400633AS	Caviar SE 16 WD3200JD-00KLBO	Caviar SE 16 WD4000KD-00NABO	Caviar SE 16 WD5000KS-00MNB0	Raptor X 150GB WD1500AHFD
Rating	★★	★★★	★★★	★★★	★★★	★★★
Pros	Five-year warranty	Five-year warranty; generally reasonable performance	Quick when writing small files	Inexpensive for a high-capacity disk	Consistently good performance	Very fast when dealing with large files, five-year warranty
Cons	Slow when writing large files or reading small files	More expensive than other 400GB disks	Sluggish when reading small files	Unimpressive performance with small files	High cost per gigabyte	Incredibly expensive, noisy
STORAGE						
Capacity	500GB	400GB	320GB	400GB	500GB	150GB
Formatted capacity (NTFS)	465GB	372GB	298GB	372GB	465GB	139GB
Price per gigabyte	46p	45p	34p	37p	55p	£1.70
Interface	SATA II	SATA II	SATA II	SATA	SATA II	SATA
Power connectors	SATA	SATA	SATA, Molex	SATA, Molex	SATA, Molex	SATA, Molex
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	10,000rpm
Cache	16MB	16MB	8MB	16MB	16MB	16MB
Quoted seek time	8.5ms	8.5ms	8.9ms	8.9ms	8.9ms	4.6ms
HD Tach access time	17.8ms	13.3ms	13.2ms	13.0ms	13.3ms	8.2ms
Platters	4	4	3	4	4	2
Heads	8	8	6	8	8	4
NCQ	Yes	Yes	No	Yes	Yes	Yes
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	28dBA	28dBA	26dBA	28dBA	28dBA	39dBA
BUYING INFORMATION						
Price inc VAT	£213	£167	£101	£139	£255	£238
Supplier	www.savastore.com	www.savastore.com	http://uk.insight.com	www.dabs.com	http://uk.insight.com	www.pcnextday.co.uk
Warranty	Five years	Five years	Three years	Three years	Three years	Five years
Details	www.seagate.com	www.seagate.com	www.westerndigital.com	www.westerndigital.com	www.westerndigital.com	www.westerndigital.com
Part code	ST3500641AS	ST3400633AS	WD3200JD-00KLBO	WD4000KD-00NABO	WD5000KS-00MNB0	WD1500AHFD



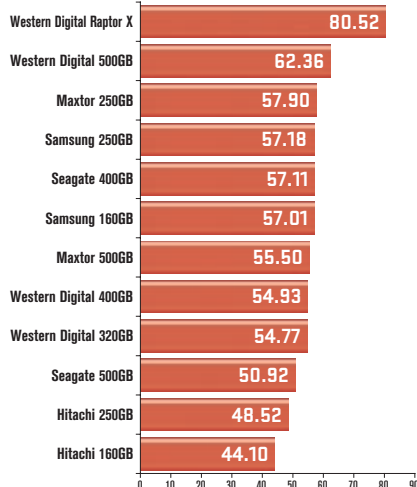
BENCHMARKS

Performance SATA internal hard disks

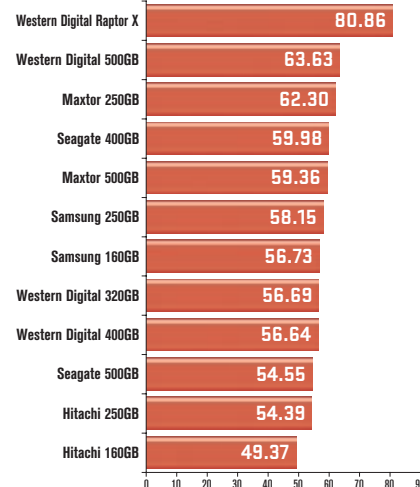
Read Large Files (MB/s)



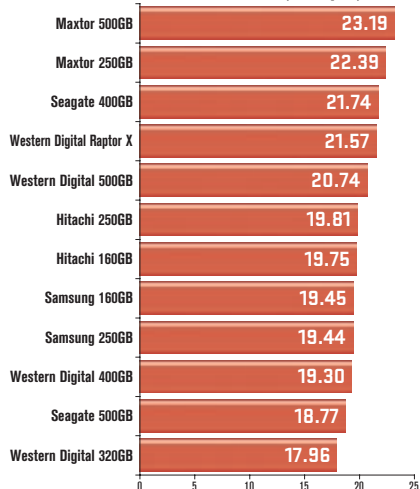
Write Large Files (MB/s)



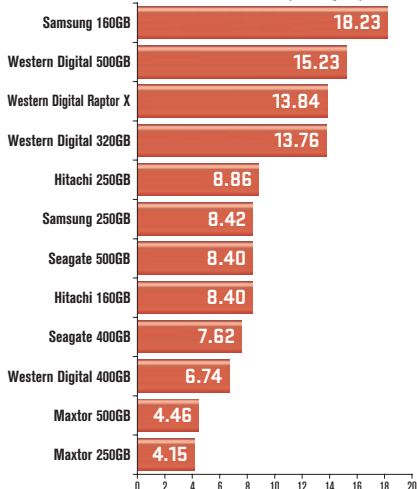
Large Files Overall (MB/s)



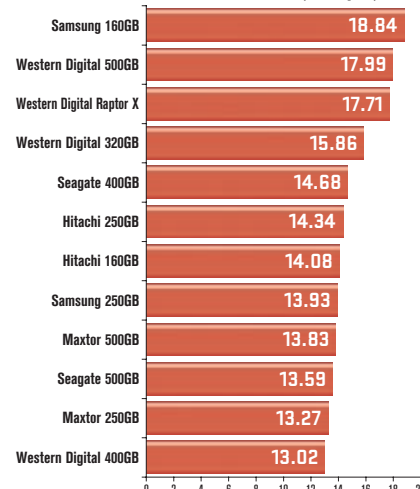
Read Small Files (MB/s)



Write Small Files (MB/s)



Small Files Overall (MB/s)



Labs verdict SATA hard disks

Most modern PCs can use a Serial ATA (SATA) hard disk. Although many PCs include PATA and SATA connectors, SATA is the simplest to use and also slightly faster. Today, SATA hard disks are only marginally more expensive than those that use the older interface.

All the SATA hard disks in our round-up have at least 8MB of cache and a spindle speed of at least 7,200rpm. Most of them use the latest SATA II interface. SATA II has a performance ceiling twice as high as the original SATA standard's, but in practice buying a SATA II hard disk is not a guarantee of better performance.

If you must have the fastest hard disk available, Western Digital's Raptor X is the one for you. It doesn't use SATA II, but it spins its platters at 10,000rpm rather than the standard 7,200rpm used by other desktop drives. It produced the best results in our large file tests by some margin, and performed well in the small files test as well. The downsides to this high-speed

technology are increased noise and a gargantuan cost of £1.70 per gigabyte.

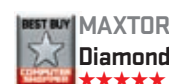
At the other end of the price scale, Hitachi's Deskstar 7K250 and Samsung's SpinPoint P80 both give 160GB of storage for around £60 including VAT. Buying either would be a false economy, though, as spending just a few pounds more gives you 250GB of storage space at a far lower price per gigabyte.

If you want to add a significant amount of storage space to your PC without great expense, we would recommend Maxtor's DiamondMax 10 6V250F0. Like all the other Maxtor disks in this group test it performed disappointingly in our small file write test, suggesting Maxtor's write buffer isn't optimised, but its performance in our other tests was far better. It's also extremely good value, costing just 28p per gigabyte. It would be a great way to add storage to a desktop PC, and it wins our Best Buy award.

For significantly more storage space at the best price, we recommend adding two or

more of these disks. Using two in a RAID 0 array will give you increased performance and almost 500GB of space, and you could buy a huge 1TB of storage space for only a little more than the cost of Western Digital's Caviar 500GB SE 16.

If you have a PC with room for only one hard disk inside, your choices are significantly limited, as none of the larger hard disks provides a convincing combination of performance and value. Western Digital's 500GB Caviar SE 16 performed well in our tests, but at 55p per gigabyte you pay a lot for the convenience of a single, large hard disk. A reasonable compromise would be Western Digital's 400GB Caviar SE 16, which gives lots of storage, performs reasonably and costs 37p per gigabyte. 



MAXTOR
DiamondMax 10 6V250F0
★★★★★

